
DMS-11011

LED Roadway Luminaires

Effective Date: JANUARY 2020



1. DESCRIPTION

This Specification governs the materials, composition and quality of Light Emitting Diode (LED) mast-arm-mounted, "cobra-head" style light fixtures (luminaires) for roadway illumination.

2. UNITS OF MEASUREMENTS

The values given in parentheses (if provided) are not standard and may not be exact mathematical conversions. Use each system of units separately. Combining values from the two systems may result in nonconformance with the standard.

3. MATERIAL PRODUCER LIST

The Traffic Safety Division (TRF) maintains the Material Producer List (MPL) of all materials conforming to the requirements of this Specification. Materials appearing on the MPL, entitled "[Roadway Illumination and Electrical Supplies](#)," require no further sampling and testing before use, unless deemed necessary by the Project Engineer or TRF.

4. BIDDERS' AND SUPPLIERS' REQUIREMENTS

The Department will only purchase or allow on projects those products listed by producer and product code or designation shown on the MPL.

Use of pre-qualified product does not relieve the Contractor of the responsibility to provide product that meets this Specification. The Department may inspect or test material at any time and reject any material that does not meet the specifications.

5. PRE-QUALIFICATION PROCEDURE

5.1. **Pre-Qualification Request.** Submit a request for evaluation under DMS-11011 to greg.jones@txdot.gov.

Include the following information in the request:

- company name;
- physical and mailing addresses; and
- contact person, phone number, and email address.

5.2. **Pre-Qualification Submittal.** For each type of luminaire submit a sample meeting all specifications, and all pertinent documentation, to the Texas Department of Transportation, Traffic Safety Division, 200 East Riverside Drive, Austin, Texas 78704.

Include the following with the sample:

- Luminaire cut sheets;
- Cut sheets for LED light sources;
- Cut sheets for LED driver;

- Cut sheets for surge protective device;
- LM-79 photometric reports of a complete luminaire meeting this Specification for each optical configuration, from a National Voluntary Laboratory Accreditation Program (NVLAP)-accredited test laboratory located in the United States, that include:
 - Name of test laboratory;
 - Report number;
 - Date;
 - Complete luminaire catalog number:
 - Include an explanation if catalog number in test report does not match catalog number of luminaire submitted, and
 - Clarify whether discrepancy does not affect performance, e.g., in the case of different luminaire housing color.
 - Description of luminaire, LED light sources, and LED drivers;
 - Input power, voltage, current, frequency, and power factor;
 - Goniophotometric report;
 - Correlated Color Temperature (CCT);
 - Color Rendering Index (CRI);
 - TM-15-11 Backlight, Uplight, and Glare (BUG) rating;
 - Photometric file in LM-63 format (i.e., filename.ies); and
 - Photos of luminaires in test position, with test number written and visible on luminaire.
- Published photometric file in LM-63 format (i.e., filename.ies) for each submitted configuration, available to the public on the manufacturer's website;
- Documentation per Section 6.1, "Quality Management System;"
- Contact information for the manufacturer's administrators or representatives who will oversee testing and tracking of luminaires built for the Department per Section 6.2, "Manufacturer's Verification Testing and Tracking;"
- Written procedure for testing and tracking of luminaires built for the Department per Section 6.2;
- Test reports showing results of 3G vibration tests in accordance with ANSI C136.31 for each size of luminaire per 6.4, "Housing;"
- Test reports showing results of ASTM B117 and QUV tests of finish per Section 6.4;
- Test reports showing ingress protection rating of IP 66 or better in accordance with ANSI C136.25 for optical assembly for each size luminaire per Section 6.6, "LED Optical Assembly;"
- Test reports showing results of electrical immunity tests in accordance with Section 6.7, "Surge Protective Devices," for each voltage range of luminaire;
- Written warranty and warranty service procedures per 6.8, "Warranty;"
- Calculations and supporting test data per Section 6.9, "Calculation of Light Loss Factor," indicating specified lumen maintenance life including:
 - LM-80 data;
 - In-situ temperature measurement test (ISTMT) reports for representative luminaires according to UL 1598. Include an explanation of how ISTMT reports relate to luminaires submitted for Department use; and
 - TM-21 analysis using the Energy Star TM-21 Calculator to predict lumen maintenance at 60,000 hr. and 25°C.
- Computer-generated point-by-point photometric analysis of maintained photopic light levels in accordance with Section 6.10, "Performance Requirements," using the submitted .ies files and light loss factor calculated in Section 6.9; and
- Nationally Recognized Testing Lab (NRTL) certification to UL 1598.

Submit all materials for pre-qualification at no cost to the Department.

5.3. **Evaluation.** TRF will notify prospective bidders and suppliers after completion of material evaluation.

- 5.3.1. **Qualification.** If approved for Department use, TRF will add the material to the MPL.

Report changes in the composition or in the manufacturing process of any material to TRF. Significant changes reported by the producer, as determined by the Director of TRF, may require a re-evaluation of performance. The Department reserves the right to conduct whatever tests it deems necessary to identify a pre-qualified material and determine if there is a change in the composition, manufacturing process, or quality that may affect its durability or performance. In case of variance, the Department's tests will govern.

- 5.3.2. **Failure.** Producers not qualified under this Specification may not furnish materials for use on Department projects.

Producers failing to qualify may submit a request for re-evaluation after 12 mo. have elapsed from the date of the original request. TRF may modify this time limit at its discretion. In the request for re-evaluation, document the cause of the issue and corrective action taken.

The Department normally bears the costs of sampling and testing; however, the producer will bear the costs associated with materials failing to conform to the requirements of this Specification. The Director of TRF will assess this cost at the time of testing, and amounts due will be billed to the producer.

- 5.4. **Periodic Evaluation.** The Department reserves the right to conduct random sampling and testing of pre-qualified materials to verify performance and Specification compliance and to perform random audits of documentation. Department representatives may sample material from projects.

Failure of materials to comply with the requirements of this Specification as a result of periodic evaluation may be cause for removal of those materials from the MPL. In case of variance, the Department's tests will govern.

- 5.5. **Disqualification.** Causes for disqualification and removal from the MPL may include, but are not limited to:

- falsification of documentation;
- producer fails to report any change in material composition or manufacturing process to TRF;
- material fails to meet the requirements of this Specification as a result of periodic evaluation; or
- producer has unpaid charges for failing samples.

TRF will remove disqualified producers from the MPL and will not allow submission of material for re-qualification for 12 mo., at the discretion of the Department.

- 5.6. **Re-Qualification.** Once the disqualification period established by TRF has elapsed, producers disqualified and removed from the MPL may begin the re-qualification process by submitting a request in accordance with Section 5.1, including additional documentation identifying the cause of the problem and corrective action taken. The re-qualification process will then follow all subsequent Sections of Article 5.

The Department normally bears the costs of sampling and testing; however, the disqualified producer will bear the costs associated with re-qualification. The Director of TRF will assess this cost at the time of re-evaluation, and amounts due will be billed to the producer.

6. MATERIAL REQUIREMENTS

- 6.1. **Quality Management System.** The manufacturer must demonstrate a commitment to quality by submitting either:

- Current ISO 9001 certification for luminaire manufacturing facilities; or
- Alternative Quality Management System documentation with the following minimum requirements:
 - Written statement of the company's quality management (QM) policy;
 - Name of employee with special QM training and with QM as his/her primary job responsibility;

- Procedure written specifically for handling orders for fixtures built to Department specifications;
- Written procedure for keeping track of fixtures built, certified, and tested for Department orders; and
- Documentation that luminaire has been designed and manufactured in accordance with the manufacturer's stated quality program.

6.2. **Manufacturer's Verification Testing and Tracking.** Sample and test the electrical and photometric properties of luminaires for each manufacturing run. Supply results to TRF for evaluation and approval. Track and report shipments of luminaires.

Before shipping fixtures, select from each lot or manufacturing run one completed luminaire for every hundred, with a maximum of two, for electrical and luminous intensity distribution testing. Select one completed luminaire from each lot for color characteristics testing. Test fixtures and supply results to TRF for evaluation before shipping. Do not ship fixtures until TRF approves the lot. Failure to conduct testing or conform to the specifications will result in removal from the MPL.

Perform electrical and photometric testing at a test lab located in the United States with NVLAP accreditation for the IES LM-79 test procedure.

Test fixtures in accordance with IESNA LM-79. Include the following data with the test report:

- Photometric file in LM-63 (i.e., filename.ies) format;
- Input power, voltage, current, and frequency;
- Power factor;
- CCT;
- CRI;
- Luminous flux;
- Luminous efficacy;
- BUG rating according to TM-15-11;
- Luminaire description; and
- Unique test number for each fixture.

TRF will evaluate and pass the batch if the submitted testing information meets the following criteria:

- All information listed above is included in the report;
- Measured power factor is 0.90 or greater;
- Measured CCT is within the limits of 6.6, "LED Optical Assembly;"
- Measured CRI is 70 or greater; and
- All photometric files meet the performance requirements in 6.10, "Performance Requirements."

If the testing information does not meet the above requirements, TRF will notify the manufacturer to correct the problem and retest.

Ensure the test lab retains the results for five yr.; provide the Department access to documentation. Retain records of manufacturing lots, test reports, lot quantities, and other pertinent details. Submit records to the Department upon request.

Track fixtures built for Department projects. Include CSJ, county, project, date shipped, quantity shipped, lot number, lot quantity, manufacturing date, and inventory balance. Account for all fixtures shipped from each lot, even if not for Department use. Email or fax tracking information to TRF within four weeks of shipments to projects. Failure to provide this information will result in removal from the MPL.

Make available to Department inspectors all manufacturing facilities involved in the production of fixtures for use on Department projects, inventories of fixtures produced to Department specifications, and records of fixture testing and tracking.

- 6.3. **General Requirements.** Provide LED luminaires listed to UL1598 and suitable for use in wet locations.

Rate luminaire for operating at ambient temperature between -40 and 40°C.

Attach external label per ANSI C136.15.

Attach internal label per ANSI C136.22.

Attach internal label or marking with date code of when fixture was manufactured.

Attach external label to each luminaire's shipment packaging showing operating voltage and fixture type, for example, "120/240V 150W EQ" or "480V 400W EQ."

- 6.4. **Housing.** Provide luminaire housing, lens frame, and door constructed from 96% copper-free aluminum.

Provide for luminaire mounting to a 2-in. pipe arm, capable of adjustments $\pm 5^\circ$ from level.

Meet ANSI 136.31, 3.0 G vibration requirements.

Paint luminaires light gray with initial gloss in the range of 30–60% (semi-gloss) when installing on galvanized poles. For all other poles, paint luminaires to match the color of the pole as directed. Use a thermoset powder-coat paint system. For pre-qualification, document that the coating meets the following:

- Exceeds a rating of six per ASTM D 1654 after 1,000 hr. of testing in accordance with ASTM B 117; and
- Exhibits no greater than 30% reduction of gloss per ASTM D 523, after 500 hr. of QUV testing at ASTM G 154 Cycle 6. Cycle 6 uses UVA-340.

Fabricate exposed hardware, nuts, bolts, washers, and metal parts from stainless steel or aluminum of adequate thickness as approved.

Attach an external level indicator to the fixture housing. Ensure that indicator is sensitive to 1° changes in position at any point within 5° of the level position. Ensure that indicator is clearly visible from the ground up to a 50-ft. mounting height. Ensure that indication of level corresponds to level position of fixture.

If external level indicator cannot be used during installation, provide internal bubble level for leveling fixture during installation.

Ensure weight of the luminaire is less than 60 lb. and the effective projected area is less than 1.6 sq. ft.

Provide a passive thermal management system. Do not use fans or other mechanical cooling systems.

- 6.5. **LED Drivers and Electrical.** Provide luminaire with replaceable LED dimming driver that will operate at 120V, 240V, or 480V line voltages as shown in the plans.

Provide drivers with a rated life expectancy of 100,000 hr. when the driver maximum case temperature, measured from the submitted ISTMT, is plotted on the Lifetime vs. Case Temperature graph for the driver.

Provide fixture with an ANSI C136.41 7-pin photocontrol receptacle and shorting cap.

Provide dimmable driver with 0-10V control, prewired to the receptacle as specified in ANSI C136.41.

Provide 150W EQ underpass luminaires with two internal 600VAC, 10-amp, Class CC, time-delay fuses and fuse holders. Fuse dimensions are 13/32 in. x 1 1/2 in.

Provide a barrier-type terminal block secured to housing for power connection to luminaire in accordance with ANSI 136.14 and ANSI 136.37. Provide lugs with screws for wire sizes up to 6 AWG. Identify each terminal position.

- 6.6. **LED Optical Assembly.** Provide LED optical assembly with nominal color temperature of 4000K. For verification testing, CCT within the range of 3710K–4260K is allowable.

Provide LED optical assembly with a minimum CRI of 70.

Ensure that optical compartment meets IEC Standard 60529-IP66.

- 6.7. **Surge Protective Devices.** Provide luminaire with a surge protective device (SPD), in addition to driver's internal protection, to withstand repetitive noise transients from utility line switching, nearby lightning strikes, and other interference.

Provide luminaire with SPD listed or recognized by a NRTL to UL 1449, 4th edition.

For prequalification, test a complete luminaire conforming to this specification for electrical immunity according to ANSI C136.2-2015. Test luminaire at the highest operating voltage of the fixture; for example, test a 377-480V fixture at 480V and a 120-277V fixture at 277V. Submit test reports showing the luminaire passes the ANSI C136.2 ring wave, electrical fast transient, and combination wave at the Extreme level of 20kV and 10kA.

- 6.8. **Warranty.** The manufacturer will replace or repair failed luminaires, when non-operable due to defect in material or workmanship, within 10 yr. of manufacture with a luminaire that meets all specifications, delivered to the project location. Photocells are subject to the warranties of their respective manufacturers.

The warranty must cover maintained integrity and functionality of:

- Luminaire housing, wiring, and connections;
- LED light sources—negligible light output from more than 10% of the LED packages constitutes luminaire failure; and
- LED drivers.

The warranty period will begin 90 days after date of manufacture as shown on internal label, or as negotiated by owner such as in the case of an auditable asset management system.

Provide documentation of warranty service procedures, including forms, manufacturer contact information, and shipping addresses.

- 6.9. **Calculation of Light Loss Factor (LLF).** For pre-qualification, submit calculations per IES TM-21 predicting lumen maintenance at the luminaire level using In Situ Temperature Measurement Testing (ISTMT) and LM-80 data. Meet all of the conditions below:

- The LED light sources have been tested according to LM-80. Provide verification from the LED or luminaire manufacturer that the LM-80 report corresponds to the LEDs in the luminaire being tested;
- The LED drive current specified by the luminaire manufacturer is less than or equal to the appropriate drive current specified in the LM-80 test report;
- The LED light source manufacturer prescribes/indicates a temperature measurement point (Ts) on the light sources; and
- For the hottest LED light source in the luminaire, the temperature measured at the Ts during ISTMT is less than or equal to the appropriate temperature specified in the LM-80 test report for the corresponding drive current or higher, within the manufacturer's specified operating current range.

The ISTMT laboratory must meet at least one of the following requirements:

- Be approved by OSHA as a Nationally Recognized Testing Laboratory (NRTL) or recognized as a participant in UL's Client Data Test Program;
- Be approved through an OSHA NRTL data acceptance program or OSHA Satellite Notification and Acceptance Program (SNAP); or
- Be accredited for ANSI/UL 1598 or CSA C22.2 No. 250.0-08, including Sections 19.7 and 19.10-16, by an accreditation organization that is an ILAC-MRA Signatory.

Conduct the ISTMT using the same configuration of luminaires submitted, or another luminaire from the same product family having:

- The same or lower nominal CCT;
- The same or higher nominal drive current;
- The same or greater number of LED light sources;
- The same or lower percentage driver loading and efficiency; and
- The same or smaller size luminaire housing.

Install luminaire as defined by ANSI/UL 1598 (hardwired luminaires).

Include in the ISTMT report:

- Photos of thermocouple locations and luminaire in testing position;
- Ambient test temperature;
- Highest LED temperature;
- Highest LED driver case temperature;
- Maximum LED current; and
- Full description of luminaire used in test.

Calculate LLF for each fixture configuration using the submitted ISTMT data, LM-80 data, and Energy Star TM-21 calculator:

- Provide documentation of in situ temperature at 25°C ambient for the luminaire rating submitted for approval;
- Calculate the lumen depreciation at 60,000 hr. at the documented in situ temperature at 25°C ambient using the Energy Star TM-21 calculator;
- $LLF = \text{Manufacturer's documented lamp lumen depreciation (LLD) factor per TM-21 calculations at } 25^{\circ}\text{C at } 60,000 \text{ hr.} \times 0.90 \text{ Luminaire Dirt Depreciation; and}$
- Total light loss factor is not to exceed 30% system depreciation (0.70) over 60,000 hr.

Calculated LLF will be used for design purposes and to determine if luminaire meets the performance specification.

6.10. **Performance Requirements.** The Department will use the measured LM-79 photometric data of sampled fixtures to verify the performance of the luminaire using the following criteria in AGI32 Roadway Optimizer. All calculations will use photopic lumens; S/P ratios will not be used.

6.10.1. **Underpass/150 Watt HPS (High-Pressure Sodium) Equivalent.**

6.10.1.1. **Layout**

- LLF as calculated in Section 6.9;
- Fixtures mounted level perpendicular to the roadway at 16-ft. mounting height, on both sides of the roadway directly opposite from each other;
- Fixtures spaced at 90 ft.;
- Setback 10 ft. from outside edges of main lanes; and

- Grid points spaced according to IESNA RP-8 for a roadway with four 12-ft. lanes.

6.10.1.2.

Test Criteria for Passing.

- Minimum > 0.35 footcandle;
- Average > 1.10 footcandle;
- Average/minimum ratio < 3.0:1; and
- IESNA TM-15-11 BUG rating with an Uplight value of U0.

6.10.2.

250 Watt HPS Equivalent.

6.10.2.1.

Layout

- LLF as calculated in Section 6.9;
- Fixtures mounted level perpendicular to the roadway at 40-ft. mounting height with 8-ft. arms, on one side of the roadway;
- Fixtures spaced at 220 ft.;
- Setback 15 ft. from outside edges of main lanes;
- Grid points spaced according to IESNA RP-8 for a roadway with three 12-ft. lanes.

6.10.2.2.

Test Criteria for Passing.

- Minimum > 0.20 footcandle;
- Average > 0.60 footcandle;
- Average/minimum ratio < 3.0:1;
- IESNA TM-15-11 BUG rating with an Uplight value of U0.

6.10.3.

400 Watt HPS Equivalent

6.10.3.1.

Layout

- LLF as calculated in Section 6.9;
- Fixtures mounted level perpendicular to the roadway at 50-ft. mounting height with 8-ft. arms, on one side of the roadway;
- Fixtures spaced at 270 ft.;
- Setback 15 ft. from outside edges of main lanes;
- Grid points spaced according to IESNA RP-8 for a roadway with four 12-ft. lanes.

6.10.3.2.

Test Criteria for Passing.

- Minimum > 0.20 footcandle;
- Average > 0.60 footcandle;
- Average/minimum ratio < 3.0:1;
- IESNA TM-15-11 BUG rating with an Uplight value of U0.